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THE COMMERCIAL KITCHEN IN THE U.S.A.

THE American loves to eat out—often and well. The sale of gas for "volume" cooking in the U.S.A. has increased regularly at the rate of 14% since 1932 and it is estimated that 85% of such cooking is done by gas in all districts reached by gas mains. A high proportion of eating places outside this range are served by "bottled" gas, *i.e.*, the liquefied petroleum residual gases, propane and butane, sold in bottles either as the undiluted vapour with a C. V. of 2,500 B.Th.U./cu.ft. or as air-gas mixture at 500 to 1,000. Hence the importance of a series of lectures recently delivered to a gathering of salesmen at the A.G.A. Commercial Gas School in Washington. These lectures are shortly to be published in book form by the American Gas Association—a book which will run to some 80,000 words and which will be a complete treatise on the vastly interesting subject of the Commercial Kitchen.

Reading these lectures one is struck by several remarkable differences between the problem as it presents itself to the American gasman and the problem we have to deal with in Britain. First, as already noted, the market is vastly greater in the U.S.A. A much higher proportion of the population takes one or more meals every day in restaurants and cafeterias. In most urban and suburban areas gas is used in from 92 to 98% of all eating places. The range of food is vastly greater for two or three main reasons. The climate ranges from temperate in the north to subtropical in the south, and the population has a wide range of racial origins each with its national feeding habits more or less persisting in their new environment. Thus the American cook has to provide meals in several Continental and Oriental styles as well as in the English-American style. And the resources are also more varied. The American is a great meat-eater. He loves fruit and salad and ices at nearly every meal.

The cooking load is a living market. Cooking, they say, has changed from a closely guarded art to an accurately controlled scientific process at least as far as time and temperature are concerned. "Much of the hocus-pocus has been taken out of it and replaced by science." Changes in cooking practice are constantly being introduced, a notable example being that of low-temperature roasting which has reduced shrinkage and waste, and given gas a potent weapon against its electrical competitor. In so highly developed a market it was not surprising to learn that two-thirds of the sales of appliances are replacements and only one-third new equipment. And the American Gas Association has recognized the importance of maintaining the quality of appliances by the institution of its scheme of testing and marking all appliances with its Seal of Approval.

"Form Value of Gas"

The treatment of the subject in these lectures was most thorough. The first gave a general account of the Gas Industry in America, marked, of course, by the big proportion of high-calorific natural gas, opening on the note: "The Gas Industry in the United States, after more than 100 years of public service, continues to expand, reaching out for new customers as well as new markets." In this expansion the use of gas in food production is one of the most important factors. Gas does the job of fine cooking "with equal satisfaction in the finest of hotels, such as the Waldorf Astoria and in the Hamburger Chains. The most modern establishments in all parts of the country, with the finest of reputations to uphold, chose gas." This encouraging opening is followed by an account of the several types of gas, their properties and the burners in which they are applied to cooking. A novel expression is the "Form Value of Gas"—the different form or use values, apart from heating value, which appeal to the user—the speed with which full heat is attained contrasted with the time lag in the use of solid fuel—flexibility enhanced by the wide-spread use of thermostatic control—versatility, a somewhat similar attribute—and economy. The American Standards Association require for the approval of a hotel range that at least 45% of the B.Th.U. delivered to the range top shall be available as useful heat. Coal or oil equipment reaches no such levels. "Only electrical equipment, higher in first cost and operating cost, can surpass them and then by a limited margin." The basis of efficiency and cost comparison were outlined, to be elaborated in a later lecture.

Dish-Washing

In the second lecture, a survey of the market, British readers will be struck by the importance attached to "dish-washing." In hotels, restaurants, hospitals, and schools, the need is found for a really hygienic solution of this problem. Many local authorities insist that all "pots" and other utensils shall be sterilized by immersion for specified times in water at 180°F. This subject is dealt with at great length in no less than three of the lectures, emphasizing its importance in the American commercial kitchen. Many types of washer are referred to, falling into two main categories, those in which the utensils enclosed in a cage are immersed first in a hot solution of detergent and then in clean hot water at 180°-210°F., and those in which they are sprayed first with detergent and then with water, both at a high temperature. The quantities of hot water used for this operation are prodigious measured by our standards. The estimate is 2 to 4 gall. of hot water per person served. Roughly this appears to mean that if the four persons of the standard family took two meals out per day they would use 150 gall. of hot water per week for this alone—a figure which is equal to British requirements for all purposes at the present rate of use.

Gas-cooking appliances are treated at great length and one whole lecture is devoted to food terminology, while another contains a lengthy glossary of the language of the trade—in which, by the way, we were shocked to find the definition of Cheddar cheese as "hard, smooth, yellow

American cheese." Perhaps there is something we had better *not* learn from our American cousins.

The use of porcelain, stainless steel and monel metal is recommended in appropriate instances, justifying a higher cost by superior appearance, particularly valuable in counter-cooking appliances as used in the cafeteria. Coffee making is more important in the States and steam-cooking and pressure-cooking are perhaps more widely used than in Britain.

Kitchen Planning

Planning the new kitchen, modernization and alteration of existing kitchens, and lay-out generally, occupied three full-length lectures. The principles are no doubt the same as those recognized here, but dish-washing, space-heating, air conditioning and ventilation are treated more fully than usual with us, the last three, no doubt, because of the different climatic conditions, in which, while heat is required in the winter, refrigeration is necessary in the summer in many parts of the country.

"Holding the Gas Load" is treated in true American fashion. "If cost were no object, every establishment would be delighted to buy new kitchen units with every change in style, just as the fair sex buys new clothes at Easter." And the salesman is exhorted to remember that "the siren song of competitive fuels is continually dinned into the customer's ear." And "it is wise to be alert to the possibilities of modernizing existing kitchens even with no competitive threat. Don't wait for it!"

The lay-out of the new kitchen is admirably treated. The commercial kitchen is described as essentially a factory for the production of food, with the added difficulty that the products are required in a wide variety, in varying quantities and must be ready at the correct time. The flow of material in and out must be closely studied—from store or outside supply to day-storage or refrigerators, to preparation tables with a side entrance from the butcher's shop and exit to garbage and refuse—thence to the cookers and from these, joined by utensils from stores and supplies from the pantry, to serving tables and the dining rooms. From the dining room back to dish-washers, with garbage to exit and utensils back to stores. This lecture contains a very fine address by Orphu Mae Thomas to the National Restaurant Association in which it is emphasized that there is no quick and easy method of planning; the work in a busy kitchen must be observed and studied. Dish-washing crops up yet again with the addition of preliminary scraping and rinsing, followed by classification to suit specialized washers for "pots," glasses, silver, &c. The several types of kitchen are analyzed—the hotel kitchen serving high-class food to two or more dining rooms (the position of the kitchen relative to the dining room is a question of high importance in all cases)—restaurants of many types from lunch or tea rooms to dining cars and night clubs—cafeterias—industrial canteens—institutions, with a large percentage of mass cooking to fixed menus—hospitals, with several kitchens for patients and staff and with their own problems of highly specialized feeding.

Competition

We have left to the last what strikes us as a novel method of dealing with competition. Our American cousins are accustomed to hitting the competitor a good deal harder than we do. He surveys the properties of other fuels. For instance, charcoal broiling is claimed to have advertising value. The customer is attracted by the display of charcoal broiling and the gas salesman gets in with gas ignition or a combination of gas and charcoal in which the speed and economy of gas are added to the glamour of charcoal (or briquette). Oil, of course, had to be treated more seriously in this land of the oil-fields. But gas holds its own even on the cost basis, while oil suffers from the disadvantages of burners with extremely small orifices liable to stoppages and the necessity of storage and from high fire risks.

Electricity is dealt with well and truly. Its claims are demolished one by one, but the salesman must study them and be prepared to meet them. First he is given an elementary knowledge of electricity itself. You must know your adversary. General claims, its romantic appeal, its alleged superiority in food preparation, speed, reduced labour costs, lower space, are readily discounted by the known facts about the wide use of gas in America's leading commercial kitchens. The claim for absence of products of combustion is unfounded because there remain the steam, fat, &c., inseparable from all cooking and because these very products of combustion make gas largely self-ventilating. The shrinkage fallacy is disposed of by well-known tests. In any case shrinkage is due to loss of moisture and fat and is not a function of the fuel used.

But the interesting feature of this section of the lectures is the term (new to us) "The energy ratio." A yardstick taking into account the efficiency of appliances, their practical utilization and the heat content of the fuel, it is really the ratio between the heat content of the quantity of one fuel and that of another required to perform a given cooking operation or set of operations. It does not take into account differences in speed or quality of performances. It is not a fixed value, it changes with major improvements in appliance efficiency, it must be re-examined from time to time, but it is surprisingly stable because improvements with one fuel are matched by improvements with another. It can be taken roughly as the ratio between heat input with one fuel and another. Tables show that kitchens compared on actual results gave gas-to-electricity 1.5; computation from rated input gave 1.62. The average figure appears to be 1.6. That is to say B.Th.U. supplied in gas equal B.Th.U. equivalent of electricity multiplied by 1.6. With such a ratio, translating roughly to English currency at 5 dollars to the pound, electricity at 0.9d. per unit could be met by gas at not more than 16.5d. per therm. Full details are given of an elaborate test conducted in 1947 by the U.S. Corps of Engineers between gas and electric kitchens for Veterans' Hospitals, in which gas showed a decided saving. A further example is given of a 1,000-bed hospital in which total costs of gas and electricity shows a saving of 200 dollars when gas is used for cooking over all-electric operation costs of 3,217 dollars per annum.

The series ends with a general lecture on customer contacts in which some 7,000 words are devoted to an account of the staffing of hotels, restaurants, cafeterias, hospitals and other institutions with interesting, and sometimes amusing, tips about the temperaments of the personnel with whom the gas salesman may have to deal. We look forward to the appearance of this outstanding and intensely interesting book in the U.S.A. in the autumn.

Commentary by "Abaris"

Design

If beauty be in the eye of the beholder, then design is in the brain of the thinker. By which I mean that many people are unable to appreciate shapeliness or form, call it what you will, because their faculties are in some way impaired. Anything will do for an enormous number of beings, who, thank goodness, are becoming daily more selective.

We are up against design at every turn on any of our works and the world's *bête noire*, if we are to believe all we read and hear, is the gasholder. Many detest these landmarks that stand up in the surrounding landscape like great tombstones, according to one past writer.

I have a fondness for the gasholder, not only because it helps to buy my lunch, but because it is a genuine piece of engineering. The water-bellied holder that goes up and down is an honest indicator of how much gas it stores; we can tell at a glance whether business is brisk, or otherwise. There is something really imposing about the gasholder that stands, impassively full, in the evening countryside.

On the other hand, there is the waterless container that sits aloofly and brazenly in its surroundings; this fellow tells you nothing and

were the gods to animate him, they would create from him a confidence trickster.

To-day's developments have shrivelled, literally, to sausages and spheres; and learned engineers debate the merits and demerits of high and low pressure systems. I can debate the virtues of neither, without disclosing an alarming innocence of the technical whys and wherefores, so I must skate gaily by with the thought that if the man-in-the-street does not like the sight of the ordinary gasholder, then he can always avert his gaze. This rotation of the optics is a far cheaper process than the building of a holder, no matter what its size, shape, or method of working.

Let us make our holders popular; let us give them personality, éclat, or that *je ne sais quoi*, by giving each a real name, painted boldly on the side where all may read and admire. Overnight the world will be filled with Alices, Marys, Junos and Ganymedes; just as the seven seas are filled with personalised ships. . . .

A Roland for his Oliver

When the Finance Bill was being discussed in the House, Mr. Oliver Stanley said: "I think that the history of electric cookers over the last 18 months ought to be published in a little pamphlet and issued to everybody in the country as an object lesson in national planning". He continued later: "But in a few weeks hon. Members on both sides point out to him that, in fact, in the vast majority of houses now being erected, if one does not cook with electric cookers one cannot cook at all . . . and the only effect of this tax was not to make people buy fewer cookers but to make them pay a bigger rent for their council house." So off the tax came again.

I do not know how many Members heard this sally, but to give his audience the impression that electricity is such an important culinary fuel is only to mislead them as to the real facts. Thousands of the new homes are equipped with gas cookers and many millions of women cook by gas; and praise be, the tax is off those cookers. It seems particularly odd that this electrical publicity should be given before the House, when every Member must be aware of the fact that the unfortunates who have been forced by geography, or the local council, to take electrical cookers will be unable to get enough electricity to cook by this winter.

The strong phrases I have quoted will nevertheless be remembered by all the hon. Members who sat in the House; and they will do as many others have done, forget that the gas cooker has no economic or practical rival.

Lachrymatory Oil Gas

Oil gas is a subject that nearly brings tears to the eyes of the honest, hard-working gas engineers of many undertakings. Not long since, the Government was exhorting one and all to put in oil burning and oil using plant, so as to save coal. Nobly was the call answered, where the materials and labour were available. Expenditure thereon was almost unstinted.

Then, lo, suddenly this far-sighted Government remembered that oil is imported; an astonishing fact that any gas-works gatekeeper could have told them. This sudden remembrance caused that august body of rulers to issue further advice, to the effect that oil must be carefully husbanded. And they crown the new dictum by adding that, after all, carburetted water gas does use up the coke, anyway; so in steps the Minister of Fuel and Power to "request" that undertakings reduce the output of that very useful C.W.G. pronto, again with a view to economizing coke.

I rarely go to the cinema so I have never seen the Marx Brothers, but I would almost bet that these brothers could handle the fuel situation with far more understanding than the present mis-handlers can evince. These screen comedians put their hearts into their work, and there is no spleen in their act; and certainly no politics. They are rivalled by our masters whose motto seems to be: "Order, counter-order, disorder." This grim tragedy would make responsible men in the Gas Industry a cohort of nervous wrecks, were the tragedy interminable. It must stop one day. All is not well in the fuel industry; all is Shinwell. . . .

Grouping

The old National Gas Council worked out a plan for regionalizing the Gas Industry, and later still, the Heyworth Report recommended the same idea. This Government is bound, sooner or later, to demand that regions be formed; just as the banks and railways were amalgamated into a handful of wieldy units; just as nationalized electricity will be re-planned.

What is likely to hold up the congregations of the thousand odd gas undertakings? Is it stupidity, stubbornness, simplicity, self-interest, speculation, suspicion, or some form of sagacity? I could wade through the whole list, eliminating one here, one there, and even then I could hardly dare to give the answer, for the subject is wrapt in mystery.

That regionalization will be difficult, there is no gainsaying, but the British Gas Council is trying to get some machinery in motion, with the co-operation of most gas undertakings. As I have said, at least two plans have been propounded, and the Heyworth plan was very logical in the overall picture. The latest memorandum produced by the B.G.C. on this important subject is an excellent one which should get few criticisms. It is well that this document is out, because it would be a villainous pity were someone to let loose a redundant civil servant to sort out the undertakings; and this is an eventuality that even now is not beyond the scope of our present rulers, the chaotics.

It is up to us to suggest as strongly as we can that we do know what the public, and we, want; and there must be no doubt in the minds of those in the Ministry of Fuel about the advice given them by our own leaders in the Industry. Even a Ministry cannot deny honest logic.

What would interest the Gas Industry most at the present time would be the names of the personnel who are nominated to serve on the various Boards. If Mr. Shinwell is still with us, we may get many shocks; so thank goodness we are resilient.

At a later stage there may be the necessity for further comment; at present all appears quiet.

The Voice

The Government have thought fit to employ a highly paid member of the public in the rôle of super-Public Relations Officer. This member was at one time in the service of the Gas Industry, which he left just after the beginning of World War II and his new task, when he gathers round him more highly paid bodies, will be to explain to his new masters what the public ought to hear. And then he will explain to the public what the Government wants *them* to hear. This is the theory of the matter and, if I may put it all into elementals, the orchestra has been so cacophonous to date that the introduction of a conductor will, it is fondly hoped, in the Shakespearean sense, get the gamut of instruments playing from one score. The great difficulty has always been the wind instruments in the orchestra; these have been improvising with results that it is feared may lose votes.

Now the same collection of instruments has been increased by the addition of a conductor and percussionists, all, ladies and gentlemen, at your expense. You will be given music that you do not want to hear, and, by Jove, you will have to pay for it, and pretend to enjoy every blessed bar.

How will it all make out? I could give you the answer, but things are depressing enough without adding my tears to the flood-tide that is going to break out shortly.

The voice of the conductor will be heard only by the instrumentalists, and the baton he wields will remain out of sight of the public. The baton, however, will be useless, because many of the players are short-sighted; and thereby hangs a tale, for there is no optician in the world who can cure the ailment that afflicts the gentlemen to whose music you will dance. Appian, the Roman historian, said that calamities make great talkers. A glance at our Sunday newspapers will prove that calamity makes for garrulity; the week-ends are akin to Babel. Perhaps the Voice will canalize all the energy wasted at week-ends.

Letters to the Editor

"The Penny Past"

DEAR SIR,—"Abaris," referring in your issue of Aug. 6 to the introduction of the prepayment meter, is correct in stating that it was adopted at Ramsgate in the year 1889. It is, however, well to bear in mind that this type of meter was introduced, admittedly in a small way, to the Metropolis by the South Metropolitan Gas Company in 1888. As the meter did not appear to be popular, its adoption was discontinued. Later, in 1892, the Liverpool Gas Company took them up with success and this success induced the South Metropolitan Gas Company vigorously to encourage their use. It might also be mentioned that whereas in 1902 there were 20 prepayment gas meters in the area of supply of the Bristol Gas Company, by 1906 the number had grown to 16,157.

Yours faithfully,

W. J. LIBERTY.

Dulwich, S.E.21.
Aug. 11, 1947.

Purchase Tax on Instantaneous Gas Water Heaters

DEAR SIR,—The British Gas Council's representations to the Chancellor made no reference to the equivalent position of the multi-point instantaneous gas water heater versus the electric immersion heater of over 3 kW loading.

Either will supply all the hot water daily required in the average home, yet the multipoint gas water heater has to bear a penal tax of 66⅔% despite the fact the Gas Industry is not overloaded, while the electric immersion heaters over 3 kW loading are tax free and readily available to the public to overload further the grossly over-loaded power stations.

Yours faithfully,

A. GRAHAM H. DIAMOND,
Director.

Ranalah Sales Corporation, Ltd.,
5, Queen Anne's Gate,
London, S.W.1.
Aug. 8, 1947.

High Pressure Holders

DEAR SIR,—While I am glad you have devoted space to this subject in an Editorial in your issue of Aug. 6, I feel that I must draw attention to certain statements which tend to give readers, in my view, a wrong conception of their suitability for certain purposes.

Thus, you state that " This type of holder has its specific place in gas-works economy and that place is almost always out on the district and is rarely within the gas-works."

Your conclusions in this respect do not coincide with my experience as set out in my Institution Paper in 1946, nor with the practice in Switzerland to which you refer and there express surprise that out of 76 pressure holders in operation in that country 38 were at gas-works and 39 at distant automatic stations.

To illustrate my point, I would add that of 28 H.P. holders in use or under construction in the Severn Valley and Gas Consolidation group, no less than 20 are or will be situated in gas-works and only eight on the district.

The reason for this is, as is probably the case in Switzerland, that low pressure holders, particularly of small size, are extremely expensive as shown in the diagram included in my Paper, and have therefore necessarily to be built of relatively large size. The normal practice used to be to build a new low pressure holder of about the same capacity in cu.ft. as the heaviest daily send-out to obtain a reasonable capital cost per cu.ft. of storage capacity. With H.P. holders these can be built in small units as the extra storage is required without being extravagant in constructional costs, and certainly the maintenance costs are very low and appreciably lower than with low pressure holders, and indeed are largely limited to external painting.

You state that " By many, pressure holders are not considered to be economic as the main storage, this no doubt being due to the fact that any gas that is to be stored at a high pressure must first be compressed."

As to compression costs, it is a fallacy to suppose that these are necessarily high with H.P. holders on works, and this is certainly not the case with any of the installations in the Severn Valley and Gas Consolidation group, as I pointed out in my 1946 Paper.

I would suggest that few if any would consider that high pressure holders were suitable for the main storage, as to compress all the gas into such holders would be a heavy item of expense, and therefore 50% of each type of storage might reasonably be taken as the normal limit of high pressure storage, though the Severn Valley and Gas Consolidation group has or will have four small works with high pressure storage in excess of this percentage.

This is due to the fact that in a works with, say, 70% L.P. holder capacity and 30% in H.P. holders, it is probable that the quantity of gas compressed will be no greater than 5% of the total gas made. Thus a manager with the above proportions of holder storage will fill the H.P. holders and then leave these for use on special occasions only and for small quantities on other occasions, nearly all the work being done by the low pressure holders. I gave instances of the low compression costs in my Paper.

There are other and somewhat contentious points to which reference is made in your Editorial, to one of which I would draw your attention. When a H.P. holder is tested hydraulically, the weight on the foundations is increased by upwards of, say, six times. I would point out that such increased weight can temporarily be taken by baulks of timber, so spreading the weight over a larger area and with the result that the permanent foundation is inexpensive and, of course far less than with the same size of low pressure holder.

I trust that you will excuse my criticisms, but I have found that your views are widely shared by others who quite reasonably have jumped to what I suggest are wrong conclusions on this question.

Yours faithfully,

G. M. GILL.

Severn Valley Gas Corporation Ltd.,
Cheltenham.
Aug. 15, 1947.

Personal

We are informed that Mr. HARRY FRIEDMAN has resigned his directorship of Friedman-Athill Ltd.—which resignation in no way alters the policy and activities of the Company.

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Sir LESLIE BOYCE, K.B.E., M.A., has been appointed Chairman of the Gloucester Gas Light Company in succession to the late Major Julian Day. Col. R. H. STUDHOLME, O.B.E., has been appointed a Director.

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Mr. WM. R. OLIVER, Public Relations Officer of the Sheffield and District Gas Company, was elected a member of the Incorporated Advertising Managers Association at a recent meeting of the Membership Committee of the Association.

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Mr. JOHN STYRING, who in 1944 was appointed Engineering Assistant on the staff of the Peterborough Gas Company, and was appointed Works Engineer two years later, has been appointed Works Engineer at Rochester for the Rochester, Chatham, and Gillingham Gas Company, and takes up his new duties on Sept. 1.

* * *

Mr. F. GARDNER has been appointed Chemist to the Hampton Court Gas Company. For the past ten years, Mr. Gardner has been a member of the technical staff of the Birmingham Gas Department, and has had specialized experience of carbonizing problems with horizontal and Woodall-Duckhams vertical retorts, having acted as Shift Chemist both on the coal testing works and on the large scale testing unit at the Windsor Street works.

Obituary

The death has occurred in Stirling Royal Infirmary of Mr. JOHN STEWART, who was a native of the town and spent 50 years with the Stirling Gaslight Company.

* * *

MR. WILLIAM LOCKEY, for some 30 years manager of Alnwick Gas Company, has died at Pinetown, Natal, at the age of 75. On retirement some years ago he joined his daughter there. He was a native of Barnard Castle.

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In the " JOURNAL " last week (p. 350) we recorded with regret the death of Mr. J. WINSON SCOTT. Sir **Frederick J. West** writes : J. Winson Scott will perhaps be best remembered for his genial personality. Of his work for the Gas Industry the record remains in the patent files and in the reputation of the great Company whom he served. The memory of his sportsmanship, his comradeship, and his pleasant relations with his fellows will be cherished by those with whom he worked and played. For many years our staff and that of our neighbours, Messrs. R. & J. Dempster, engaged annually in friendly games and contests in and out of doors. The winter games were rounded off by an evening meal and a convivial gathering at which the cup was handed to the winners of the highest aggregate number of games, each staff having the honour of playing hosts to the other in turn. Mr. Winson Scott was the life and soul of these contests, in which he took part right up to their compulsory suspension in 1939, and to these friendly gatherings he nearly always contributed some item of the entertainment, his fund of Lancashire stories and character sketches being inexhaustible. Indeed the cup itself was his own gift.

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The death occurred on Aug. 12 of Mr. W. H. T. JOHNS, Engineer and Manager of the Warrington Gas Department, at the early age of 40. Mr. Johns, who was a victim of infantile paralysis and was on holiday at the time of his death, was the elder son of Mr. W. T. Johns, formerly Engineer and Manager of the Swansea Gas Light Company. After serving his articles with the late Mr. H. D. Madden at Cardiff he joined his father at Swansea for a short time and was then appointed second Assistant to Mr. L. E. Twycross, of the Cheltenham and District Gas Company. In 1933 he was appointed Deputy Engineer and Manager of the Burnley Gas Department, and three years later he became Engineer and Manager of the Rotherham Gas Department, where he made good use of the experience he had gained at Burnley in connexion with the bulk purchase of coke oven gas. He became Engineer and Manager at Warrington in January of last year. Keenly interested in sport, Mr. Johns was an old public school Rugby football player, and continued his interest in the game by playing for Glamorgan Wanderers while at Cardiff, and for the Old Patesians while at Cheltenham. He was also a keen swimmer and was a playing member of the Cheltenham Water Polo Club while he was at Cheltenham.

Diary

Sept. 9.—National Federation of Gas Coke Associations: General Committee, Gas Industry House, 10 a.m.

Sept. 16.—National Federation of Gas Coke Associations: National Technical Committee, Gas Industry House, 11.30 a.m.

News in Brief

The Hawick Branch of the Women's Gas Council is planning an energetic winter session. A visit to the "Enterprise Scotland" Exhibition is proposed, and at the opening meeting to be held on Sept. 17, Miss M. Andross, of the Glasgow and West of Scotland College of Domestic Science, will give a demonstration. of fruit canning

The Ministry of Fuel and Power has approved the installation of a low pressure main for the supply of gas to Withnell by Blackburn Corporation Gas Committee. Application is to be made for sanction to borrow £20,000 to cover the cost of necessary plant and equipment for such extensions.

The Shotley Bridge and Consett Gas Company are to apply for an order to increase their share capital and borrowing powers. The Company proposes to raise £30,000 new capital—£15,000 5% consolidated stock and £15,000 3½% redeemable debenture stock—in order to maintain and develop the Company's business by the installation of new plant, gas mains, and other equipment, together with the replacement of amount overspent on capital account.

Employees of Denny and Dunipace Gas Department met in a social capacity in the Town House recently on the occasion of presentations to two of their colleagues. Mr. James Waddell, Assistant Gas Manager, presided, and after tea Mr. R. M. Simpson, Engineer and Manager, presented a monetary gift to Mr. Andrew Boyle on his retirement under the age limit after 26 years' service, and to Miss Margaret Dick, who has been transferred to the Burgh Chamberlain's Department.

Morley will not join the 50 odd local authorities in the East and West Ridings who have set up Fuel Efficiency Committees. Only eight people attended a public meeting at Morley Town Hall to hear a Ministry of Fuel and Power speaker appeal for a "fuel conscious" public. Domestic and non-industrial consumers, he said, had to save 2,500,000 tons of coal by economy in the use of gas and electricity between now and the end of the year. The Mayor of Morley (Alderman John Dews), who presided, said an efficient committee could not be formed from the small number present.

An Extraordinary General Meeting of the Manchester and District Junior Gas Association will be held at the Gas Showrooms, Manchester, on Sept. 20, at 2.30 p.m., to consider alterations in the by-laws. Proposed deviations from the present bylaws include (1) alteration of the title to "Manchester District Junior Association of Gas Engineers"; (2) examination qualification for membership; (3) creation of various classes of membership; and (4) increased subscriptions. The business will be followed by the showing of some of the latest Gas Industry films.

Exhibits for "Enterprise Scotland, 1947," the Scottish National Exhibition of Industrial Design which opens in Edinburgh on Aug. 25, have now been chosen by the Selection Committees whose emphasis has been on good design, craftsmanship, and finish. The measure of support accorded this Exhibition of Scottish Industry is revealed by the very high percentages of firms in the various industries who have submitted designs. Manufacturers of domestic appliances whose goods have been selected for the exhibition include: Acme Wringers, Ltd., British Vacuum Cleaner and Engineering Co., Ltd., Buccleuch Radio Manufacturers, and R. and A. Main, Ltd.

A Member of the Staff of the Wigan, Leigh, and District Workshops for the Blind was so enthusiastic about her gas cooker fitted with a Braille Regulo, that the Superintendent arranged for a demonstration to be given at the Workshops during a bi-weekly social gathering. The audience of 50 blind people, men and women, were told how the Braille Regulo operates and the Braille cooking chart was read aloud by a blind visitor. The Regulo was then passed round for inspection. Questions were asked and the replies given by the Superintendent, the Home Teacher, and a staff member of the Wigan Corporation Gas Department. The Braille Regulo and Chart, made by Radiation for certain types of New World cookers, was sent to the Workshops from Essex Works, Birmingham.

To Meet Increasing Demand for Gas, Lanark County Council has agreed to purchase an area of ground of some 16 acres, on which to erect an extension to the present works at Uddingston. The new site lies to the east and north of the gas-works, which are linked by high-pressure mains with the works at Cambuslang and gas delivery conditions can be operated as desired between the two works. Gas used by domestic and industrial consumers now exceeds 900 million cu.ft. per annum, and the amount of smokeless fuel produced is about 20,000 tons. Dependent on industrial development, production in the near future is estimated at about 5,500,000 cu.ft. per day. A high-pressure main is being laid from the manufacturing centre at Uddingston to Bellshill, Newhouse, Chapelhall, and the east areas generally. Including industrial estates, the probable gas loads in these areas are estimated at about 4,500,000 cu.ft. per day. The new transmission line will become an integral part of the gas high pressure system throughout the area of supply, including the industrial districts.

Richmond (Yorks) Gas Department shows a net loss of £590 compared with a profit of £398 last year due to increased costs of labour and coal. The Town Council has decided to ask the Ministry of Fuel and Power for permission to raise the price of gas sufficiently to cover production costs next year.

The Trade Statistics for April, 1947, just issued by the Department of Industry and Commerce in Eire, show no imports of gas coal, as against 23,344 tons, valued at £66,969, in April, 1946. This leaves the total of these imports for the first four months of 1947 at 24,718 tons, valued at £75,288, compared with 70,842 tons, valued at £201,397, in the corresponding period of 1946.

The Minister of Health, Mr. Aneurin Bevan, M.P., has written to thank the British Gas Council for its co-operation in making the recent Hospital Domestic Aids Exhibition so successful. The Minister added that "about 2,500 people, of whom more than half were representatives of hospital authorities, visited the exhibition, and I am certain it will have given them valuable guidance on the ways in which mechanical devices can be brought in to assist in hospital domestic work. The organization of the exhibition was a most excellent job, and I shall be grateful if you will convey my thanks to all concerned."

Leeds Gas Committee has considered a report by the Engineer and General Manager, Mr. C. S. Shapley, on gas charges in the city. At the last meeting of the Committee it was reported that the Department's deficiency for the year ending Mar. 31 was £72,422, following a deficiency the previous year of £11,641. The report showed how heavily production costs have increased since 1940, when the last increase of 6d. per 1,000 cu.ft. was made. No immediate decision on any alteration is likely to be made. The policy of the City Council, it is understood, is to wait until something more definite is known of the Government's intention regarding nationalization. Last year's deficiency was met out of reserve, which now stands at £30,769.

WOMEN'S HOUR

In the "Women's Hour" on July 25 the B.B.C. gave a ten minute broadcast from the Beckton gas-works and the Beckton products works of the Gas Light and Coke Company.

Mr. L. W. Blundell, Superintendent of the Products works, Mr. J. Sach, and Mr. D. G. Murdoch gave a brief picture of the by-products side of gas making and the uses to which some of them are put. They stressed the way in which the housewife meets chemicals from the gas-works every day, and mentioned dyes, essences, plastics, and nylon, among others.

The feminine side was emphasized by the introduction of Miss Ethel Eldred, who, during two wars, had worked in the naphthalene plant in the products works.

The Deputy Station Engineer of Beckton (Mr. G. Dougill) introduced a few remarks on gas manufacture at the beginning of this broadcast, which was heard by about 6,000,000 listeners.

NATIONAL JOINT COUNCIL FOR GAS STAFFS

Last October application was made to the Federation of Gas Employers for the setting up of a National Joint Council for Gas Staffs and on Nov. 12 the Central Committee of the Federation agreed that such a Council should be set up by the Federation and those Trade Unions which can claim to represent the non-manual employees of the Industry. Four organizations, the British Gas Staff Association, the National Association of Local Government Officers, the National Union of General and Municipal Workers, and the Transport and General Workers Union are represented on the staff side.

The Federation requested in December that, in view of the imminence of the setting up of the Joint Council, local negotiations should cease, as, in their opinion, chaos would be caused if local agreements were made which would be superseded almost immediately by national agreements. Under the impression that the Joint Council would be established within a few weeks, the unions have, therefore, not generally pursued local negotiations.

The constitution was drafted in March by officers of the Federation and the unions concerned but in June the Federation informed the unions that it would be necessary for the member-undertakings to agree individually to participate in the proposed Council and that the employers' side could not be formed until a sufficient number of acceptances had been received. The Federation, however, has agreed that, as negotiations had previously been commenced in the London District, a London Regional Joint Council should immediately be set up with the unions concerned.

CANADIAN GAS ASSOCIATION

At the Annual Convention of the Canadian Gas Association held at Niagara Falls, Ontario, on June 9-12 the Institution of Gas Engineers was represented by Dr. J. G. King, Director of the Gas Research Board. It was the first occasion that a representative of the Institution has attended the Convention since the memorable visit of about 60 members of the Institution to Canada and the United States in 1933.

Presentation of the Institution Silver Salver to the incoming President. Left to right: Mrs. Weir, Dr. J. G. King, Colonel Thomas Weir (Chatham, Ont.), retiring President, Mr. F. A. Brownie (Calgary, Alb.), the new President, and Mrs. J. G. King.

At the request of the President of the Canadian Gas Association (Colonel Thomas Weir, Chatham, Ontario), Dr. King handed to the President-Elect (Mr. F. A. Brownie, Calgary, Alberta) the inscribed silver salver presented to the Association by Mr. F. P. Tarratt, then President of the Institution of Gas Engineers, on behalf of all members of the Institution, during the 26th Canadian Gas Convention in Ottawa in September, 1933, which has ever since been passed on to the incoming President of the Association. In so doing, Dr. King assured the Canadian Gas Association of the keen and continued interest of the Institution in all its activities and in developments in the Canadian Gas Industry.

UNPRECEDENTED EXPANSION AT STOKE-ON-TRENT

Gas sales at Stoke-on-Trent in the year ended Mar. 31 reached 4,796 million cu.ft., an increase of just under 1,000 million cu.ft. or 26.13% over the previous year. Annual increases over the past 20 years have averaged 122 million cu.ft., so that the past year's expansion is equal to eight years' normal growth.

Mr. J. E. Stanier, Chief Engineer and General Manager, in his annual report, points out that even higher sales would have been recorded but for the compulsory industrial cuts and the suspension of street lighting. A new six million cu.ft. per day Glover-West vertical retort installation and ancillary plant has been completed, and other extension work now in course of construction includes a five million cu.ft. waterless holder; eight million cu.ft. per day dry purification plant; and a six million cu.ft. per day carburetted water gas plant in two units of three million cu.ft. Negotiations are also proceeding for a further supply of purified coke oven gas.

The total quantity of gas made and received increased by 914,266,000 cu.ft., or 22.7%. The Etruria Works produced 37.3% more than in the previous year, and the quantity of coke oven gas received was higher by 204,277,000 cu.ft., or 9.67%. Industrial gas sales rose by 761,148,800 cu.ft. to a total of 2,593,928,500 cu.ft. There are now 100 gas-fired tunnel kilns installed throughout the district compared with 66 for the last pre-war year, and subject to materials being available it is expected that a further 20 kilns will be completed during the coming year.

The price of gas to domestic and other small consumers has remained unchanged since 1940. Since October, 1946, larger consumers have been charged slightly increased rates, bringing all classes of consumers on to a common basic increase of 4¼d. per 1,000 cu.ft. above pre-war prices. The average price realized for all gas sold was 2s. 1½d. per 1,000 cu.ft., which is actually 1½d. per 1,000 cu.ft. lower than the figure for 1937 and is also below that of the two previous years, 1945 and 1946, namely, 2s. 2d. and 2s. 1.9d. respectively.

Gross profit transferred to net revenue account was £113,356 against £81,677, which after deducting redemption and interest charges, &c., gave a net profit to be carried to reserve account of £50,065 compared with £19,961 for the previous year. Capital expenditure during the year totalled £232,548. It is significant that despite such a large expenditure the outstanding debt per million cu.ft. of gas sold was only £182 5s. 10d. compared with £182 6s. 5d. in the previous year. Ten years ago the corresponding figure was £309 14s. 10d.

SHEFFIELD STREET LIGHTING

The wartime and post-war problems of public lighting are vividly portrayed in the tenth report of the Sheffield Corporation Lighting Department, covering the years 1939-1947. Mr. J. F. Colquhoun, Lighting Engineer, reviews the successive stages of the period—total blackout, "starlighting," "moonlighting," seasonal blackouts, restoration of full lighting, economy cuts, and finally the fuel crisis blackout. Immediately prior to the fuel crisis there were 13,210 electric and 12,563 gas lamps in use; since Feb. 12 the numbers have been reduced to 1,685 and 263.

During the war many lighting fittings were removed to storage. Men who had not joined up became redundant and other Corporation departments co-operated in placing them in other jobs. When "starlighting" was introduced there were not enough men available and it was necessary to employ women lamp attendants. The Labour Exchange was asked for robust women, and the first lady they sent weighed 18 stones. "Eighteen stone of robust womanhood perched on a ladder cleaning a street lamp drew comments (not all of them polite) from certain members of the Sheffield public. Unfortunately the lady's courage was not equal to her bulk, and she promptly gave up the job." But the Department persisted and in a short time a woman attending to street lamps caused no comment.

Immediately after air raids the workshops received for repair more lanterns in three days than were normally received in 12 months. Gas clock controllers for months afterwards were recovered from roofs and gardens far removed from their original site.

Sheffield was the first city in the country to return to full lighting when peace was declared, and in one night 25,000 lamps were put into operation in the 666 miles of the area. The period of full lighting was short-lived because in the interests of economy all the lamps in the side streets had to be extinguished from midnight from Oct. 15, 1945. At the time of the fuel crisis all street lighting was discontinued except that on tram routes, and the lamp attendant staff was again disbanded, but more work than ever was imposed on the erecting, maintenance, and repair staff brought about by malicious destruction of street lamps.

INDIAN SCOUTS AT BRENTFORD

Thirty-five Indian scouts—visiting Europe for the Paris Jamboree—went to the Brentford works of the Gas Light and Coke Company a few days ago. This followed their official attendance at Buckingham Palace.

The Indian Scouts at Brentford Works pose with Mr. Mead, the Deputy Engineer.

None of the party had heard of gas before coming to England, and they were—to say the least—agreeably surprised at the ramifications of a gas-works.

This particular party will spend some months in Europe visiting all the capitals before they return to India.

Whessoe, Ltd., announce that they have been placed by Lloyds Register of Shipping on their list of recognized manufacturers of Class I Welded Pressure Vessels (Fusion Welding). In the manufacture of welded pressure vessels for liquid and gas storage, for heat exchange and chemical processes, the Company has been for many years a Lloyds approved firm. The Class I Certificate now given signifies approval of the extended facilities available for the design, manufacture, and stress relief of vessels of considerable dimensions and wall thickness. These services include mechanical and metallurgical testing and radiographic examination. The Company is now able to carry out the manufacture and testing of a range of welded work to purchasers' requirements both in conformity with Lloyds Class I Code and to other approved codes.

IMPRESSIONS OF THE FRENCH GAS INDUSTRY

By JOHN W. PALLISTER, M.Inst.C.E., M.Inst.Gas E.
(Engineer and Manager, Middlesbrough Gas Department)

THE writer had the privilege of attending the 64th Congress of the Association Technique de l'Industrie du Gaz en France, as the representative of the Council of the Institution of Gas Engineers. The Congress was held at Pau, in the Basses-Pyrénées District of South West France, from June 16 to 21, and was attended by gas engineers from all parts of France. Until a few days before the Congress was due to commence, it appeared extremely doubtful whether it would be held, due to the nation-wide strikes in railways and transport, as well as in the Gas Industry. Indeed, the strikes were still continuing when the writer left with his car via Dover and Ostend; the dockers were refusing to unload cars at Calais. However, on arrival in France from Belgium it was found that the strikes had been settled.

Natural Gas

An important feature of the business of the Congress, as well as the visits of inspection, concerned the collection, distribution, and utilization of natural gas, of which France has been fortunate in discovering a considerable source of supply. In 1939, just prior to the outbreak of war, an exploratory well was bored at Saint-Marcet in the Saint-Gaudens District on the foothills of the Pyrenees in south west France, which yielded an abundant supply of natural gas. The Germans accelerated the work during the war and developments have since continued and further extensions are in hand. The quantity available is believed to provide reserves for many years.

A pipeline was laid in 1942 to Toulouse which was the first large town in France to be supplied with natural gas. Three years later, in December, 1945, the town of Tarbes received a supply. To-day a grid of 187 miles of pipelines has been extended over the south-west region supplying, in addition to Toulouse and Tarbes, the towns of Pau, St. Gaudens, St. Girons, Pammiers, &c. The total sale of natural gas is now 16 million cu.ft. per day. Further extensions of the grid are at present being made which will add an additional 250 miles of pipelines to the system and will permit the sale of 42 million cu.ft. of gas per day. These further extensions will be made through Agen in a north-westerly direction to Bordeaux.

The wells are bored to a depth of about 6,000 ft. and a derrick drill was seen in operation which drilled a distance of between 33 and 50 ft. per day. The gas is released from the wells at a pressure of 1,988 lb. per sq. in., from whence it proceeds to a decompression station where the pressure is reduced to between 426 and 568 lb. per sq. in., with the deposition of a considerable quantity of petrol and water vapour, which would otherwise cause trouble through condensation in the mains, followed by washing with gas oil in absorption towers where the remainder of the petrol is recovered. This plant is of very small dimensions owing to the high pressures available. A useful quantity of petrol is recovered for motor transport, and considerable use is made of the compressed gas in cylinders for motor vehicles.

Small Diameter Pipelines

Owing to the high pressure at which the gas is released, pipelines of very small diameter are sufficient to transmit the gas over considerable distances without the expense of compression. The pipe to Toulouse is only 6 in. diameter; to Pau 5 in. diameter, and to Saint-Gaudens 4 in. diameter. The 6 in. main to Toulouse put into service on Nov. 11, 1942, had been calculated for a delivery of 5 million cu.ft. of gas per day, with an initial pressure of 355 lb. per sq. in. The use of gas for industrial purposes increased to such an extent, however, that the main became inadequate, and a compressing station was installed to increase the pressure to 852 lb. per sq. in., with a delivery of 14 million cu.ft. of gas per day until a new main could be laid. An additional main of 12 in. diameter is now in hand.

The calorific value of the natural gas, after the deposition and abstraction of petrol, is 1,067 B.Th.U. per cu.ft. Considerable thought was given to the difficulties of using pure natural gas in existing consumers' appliances and the impossibility of changing these, and it was finally decided to distribute a mixture of natural gas and coal gas. The calorific value of the mixture has been determined at 618 B.Th.U. per cu.ft., this being the maximum quality which could be utilized in existing appliances, and at the same time increasing the thermal capacity of the grid lines and effecting an important economy in coal required for carbonization. The mixing of the natural gas and coal gas (produced in Glover-West vertical retorts) is carried out in a small room at the Tarbes gas-works, 33 ft. square, with automatic control of calorific values.

The French Gas Industry is to be congratulated on its development of this free gift of nature, and to be envied in its good fortune in its location. Exploratory boring for oil was carried out in this country during the war, including several borings in the Cleveland Hills of North Yorkshire in the writer's area, but the results were veiled in wartime secrecy. It is believed that though no oil was found, natural gas in small quantities was present. It would be interesting to have details published.

Nationalization

Nationalization, which has already been in operation in the French Gas Industry for a year, was the subject of much animated discussion among the delegates throughout the period of the Congress. The writer heard many views expressed, but finds it impossible to draw any conclusions on the information available. There is a substantial deficit on the financial results of the year. The nationalized gas and electricity industries are run jointly, as the gas and electricity undertakings in many towns were already run by one company. In the early days, when electricity was introduced, the gas companies also extended into electricity supply, or in some cases bought the electricity undertakings to avoid competition. Hence the utilization of gas is not on such an extensive scale as in this country. From conversations with representatives of the former owners of gas companies, gas engineers, and Government representatives, it was agreed that it was difficult to give any clear picture of the results of nationalization at this stage. The Industry had certainly been through a difficult period when taken over, and their finances were in poor shape, since they had not been allowed to increase their charges for gas to meet the increased costs of materials and labour. Repairs and renewals were also in arrear.

In addition to the technical visits, excursions were made during the week of the Congress on the Pyrenees to the Pic du Midi and Col du Tourmalet, and to the Grotto at Lourdes. The writer and his wife were welcomed with the utmost kindness and made many friends, and have very happy memories of a delightful visit to a most beautiful part of France.

ELECTRICAL TESTING

(CONTRIBUTED)

The employment of any kind of power requires safeguards, and electrical energy is no exception. Thus regulations have been drawn up by the various competent authorities to eliminate as far as possible the causes of failure and accidents. Further, owing to the severe conditions met with in gas-works, the strict observance of these regulations is of paramount importance.

Faults on electrical machinery are generally due to one of two causes. One is the absence of continuity in the conductor which is supposed to be carrying the current, the other is absence or partial absence of insulation. The latter is by far the more common and the more dangerous of the two faults. A burnt-out armature, for instance, is usually due to insulation failure. It is of the utmost importance, therefore, to make regular tests on the insulation resistance of all electrical machinery so as to detect incipient faults and so prevent electrical breakdowns and the risk of shock to personnel.

There are probably many people who do not appreciate that the insulation of electrical equipment deteriorates gradually and inevitably quite apart from any accidental damage. This deterioration is generally due partly to the absorption of moisture and the perishing of insulation, but chiefly to the accumulation of dirt and condensed moisture on the surface of the insulation. Further, the insulation resistance of motors and generators decreases with rise of temperature, as the insulation varnishes used in the building of machines have a lower resistance when hot then when cold. Moreover, as the leakage current through the insulation itself produces heating, it will be realized that the deterioration of the insulation due to temperature is, to a certain extent, cumulative. It is necessary, therefore, that the insulation of electrical plant be regularly tested so that any doubtful apparatus may be removed for overhaul before actual failure takes place. Convenient instruments for insulation tests are the "Megger" testing set or "Meg" insulation tester, both of which are manufactured by Evershed & Vignoles, Ltd., of London. Each instrument contains a hand driven generator producing the correct test voltage and an ohmmeter enabling the insulation resistance to be measured directly on a scale.

In a gas-works, where excessive corrosion may eat away an earth connexion in a comparatively short time, the need for testing the continuity and resistance of the earthing circuit cannot be overemphasized. Some "Megger" insulation testers are fitted with continuity ranges to enable the resistance of the earthing conductor to be measured, but where it is considered desirable to pass an appreciable current, there is an instrument used largely in the "Megger" earth circuit continuity tester manufactured by the same firm.

GAS DEVELOPMENT IN WEST YORKSHIRE

The contract for the major portion of a £1,250,000 carbonizing plant to be built at Tingley, West Yorkshire, has been placed with the Woodall-Duckham Company by the United Kingdom Gas Corporation on behalf of its subsidiary, the West Yorkshire Gas Distribution Company. We give here an outline of the plant to be erected.

THE new carbonizing plant will, when completed, comprise 144 recuperative intermittent vertical chambers arranged in four rows of two benches in tandem. Each bench will contain 18 chambers. The building of the plant will be undertaken in two stages, the first of which will comprise two rows of two benches totalling 72 chambers with coal handling plant for the ultimate installation and coke handling and screening plant and coke storage arrangements for the first part.

The completed installation will be capable of carbonizing 1,000 tons of coal and of producing 14 million cu.ft. of 505 B.Th.U. gas per day after extracting benzole at the rate of 2 gall. per ton of coal carbonized. The chambers will be heated by hot producer gas made in producers built into the settings. The ultimate installation will be provided with six waste heat boilers of which three will be embodied in the first stage and will be erected in a steel-framed brick-panelled and embellished building.

Each pair of benches will be designed as a self-contained unit in that it will be provided with its own coal charging car, hot coke skip, quenching tower, gas governor, waste gas flue and chimney, and tar and liquor system.

Chambers and Heating System

The chambers will be the latest Woodall-Duckham recuperative type and will be about 21½ ft. high, 10 ft. long, and 12½ in. wide at the bottom and will have a capacity of approximately 3⅜ tons of coal per charge. The width will increase evenly from top to bottom to ensure unaided discharge of the coke when carbonization is complete. Each bench of 18 chambers will be divided by means of division walls into three sections of six chambers each. These division walls are designed to be air cooled when desired, which will enable any section of a bench to be repaired without interfering with the working of the others. The design of the heating system will be such that while the flow of gases will take place in an upward direction the gases will be constrained to travel backwards and forwards from end to end of the chamber through horizontal flues during their natural upward flow. Producer gas will be admitted to the heating flues at one level and secondary air at three levels.

Each section of six chambers will have a step-grate producer and two counterflow recuperators, all of which will be built into the setting and will rise from the ground floor to the full height of the bench.

The coal handling plant, which will be capable of dealing with 240 tons of coal per hour, is arranged in duplicate breaking and conveying systems both of which would be in operation for the normal coaling of the complete plant but either of which can act as a standby to the other.

Coal will be brought into the works in railway wagons on the works siding where duplicate wagon tipplers will be situated. The tipplers, each of which will be capable of handling 20 tons capacity wagons, will discharge the coal into a coal receiving hopper beneath the tracks. This hopper will have a capacity of 50 tons of coal. From the receiving hopper coal will be delivered by duplicate scraper conveyors to duplicate single-roll coal breakers of the " Jeffrey " type capable of reducing the coal over 2 in. in size to a maximum of 2 in. cube. Screens will be provided in the delivery chutes to the breakers to pass coal under 2 in. to the by-pass chute, while provision will also be made for completely by-passing the breakers when small coal is used.

From the breakers and by-pass chutes the coal will be fed to duplicate band conveyors and elevated thereon to the top of the chamber house where it will be delivered on to either of two shuttle-band conveyors. The coal hoppers will have a capacity equal to 72 hours' supply to the chambers. The small coke for the chamber bottom pads and the coke used as fuel in the producers will be fed from overhead storage hoppers situated between the benches. These hoppers will have a capacity equivalent to 48 hours' supply to the chambers and producers.

The chamber charging car will be electrically propelled and top hung. It will be fitted with triple measuring chutes which will be lowered into the chamber tops via a self-centering device before the charging operation commences to ensure a uniform level of the charge in the chamber and prevent any possibility of spillage. A specially designed smoke sealing device is attached to these chutes. The design of the car is such that the coal is automatically cut off when the correct quantity has been charged. The car will also be fitted with a compartment for carrying the coke required for the pad at the chamber bottom and the necessary measuring chutes for depositing this coke. A specially designed fume extraction plant with travelling fume extraction chutes will be provided to reduce the smoke nuisance to a minimum.

Each chamber will be fitted at the bottom with a hydraulically operated discharge door. The charge will be dropped into the hot coke skip which will run on rails set into the floor beneath the chambers. The skip will be of the bottom discharge type and will be hauled by electrically operated chain haulage gear into the quenching tower. Here a series of overhead water sprays will quench the hot coke with a pre-determined quantity of water. The quenching water pump will be electrically controlled from a float in the quenching water tank to ensure automatic replenishment in the tank.

Gas Collecting System

At one end of each chamber there will be a top gas offtake consisting of an arched cast-iron pipe leading to the top collecting main which runs along one side of the bench. Each top offtake will be provided with a liquor spray and a special dish valve whereby the offtake will be kept sealed from the time of discharge until the chamber has been recharged. Sprays will also be fitted in the top collecting main.

Each chamber will also be provided with a bottom gas offtake leading into a bottom collecting main. The bottom gas offtake will be designed to function when gas evolution is exceptionally rapid and excessive pressure on the brickwork and ironwork at the bottom of the chambers might otherwise occur. The device which will provide for this will consist of a vertical dip pipe sealed in liquor in the bottom collecting main.

The liquor and any tar which may be deposited in the top collecting mains will pass through downtakes into the bottom collecting mains which are fitted with cleaning sumps and an adjustable tar and liquor overflow connected to a tar and liquor separating tank. Here the tar will be deposited and will rise over an adjustable weir whence it will flow to the tar wells. The liquor will be decanted into a clean liquor compartment whence it will be pumped back to the sprays in the top collecting mains and offtakes.

The gas from the bottom collecting mains will pass through uptakes into the top collecting mains whence, together with the gas collected in this main, it will pass through further uptakes into the foul main. The pressure in the foul mains will be controlled by Bryan-Donkin governors of the gas relay type, and Peebles automatic safety relief valves with vent pipe to atmosphere will also be provided. The bottom gas offtakes will be utilized for the admission of steam to the chambers for steaming the charges during the later stages of carbonization.

The waste heat boilers, of which there will be three in the first stage and ultimately six, will be of the Woodall-Duckham horizontal fire-tube induced-draught type designed for a working pressure of 150 lb./sq.in. The complete waste heat boiler plant will be capable of generating 960,000 lb. of steam " from and at " 212° F. when the chamber plant is in full operation.

Coke Handling

The coke, after being quenched, is discharged to a receiving hopper arranged below ground level and at the coke handling end of each pair of benches. There will be two receiving hoppers in the first stage although four will ultimately be provided. From these hoppers the coke will be fed by means of chutes on to duplicate De Brouwer conveyors. Four of these conveyors, each of which will be capable of handling 40 tons of coke per hour, will be included in the ultimate installation although only two will be included in the first stage of each pair of conveyors. Either conveyor will be able to handle the total quantity of coke if necessary.

The De Brouwer conveyors will feed the coke via chutes on to duplicate band conveyors which will elevate the coke to the screening and storage plant or alternatively via a system of fixed and shuttle band conveyors, which will be incorporated in the second stage, to open storage.

An ash collecting and handling plant will be provided to deal with the ashes from the producers and will consist of two units one of which will be supplied in the first stage. Each unit will comprise an ash receiving hopper, a bucket elevator, and an elevated storage hopper. The ash will be collected in Lister mechanically propelled trucks and conveyed to and tipped into the receiving hoppers alongside the rail tracks in the works yard. From each hopper the ashes will be raised in a bucket elevator and discharged into an elevated ash storage hopper above the rail track. From this hopper the ash may be discharged through a bottom outlet fitted with a quadrant door directly into railway wagons or through an additional outlet with a quadrant door into road vehicles.

A Window Display in the Showrooms of the Bradford Gas Department won first prize in the Bradford Centenary Window Display Competition organized by the Bradford Chamber of Trade. The display was a centre of attraction during the celebrations. The Department was also represented at the Centenary Exhibition held in Cartwright Hall by a display of modern appliances, together with the " Uluplex " package kitchen unit, and a scale model of Birkshall gas-works.

THE HIGH-PRESSURE GASHOLDER*

By M. NOONE (Chief Engineer) and A. G. GRANT, M.Sc., Assoc.M.Inst.Gas E., M.I.Chem. E.
(Director and General Manager), Whessoe Limited

(*Continued from p. 366*)

GOOD pressure holder practice, as regards the type and attachment of manholes and branches, is in line with that established for steam boilers and air receivers and meeting the requirements of the Factories Acts and Insurance Codes. For riveted construction, no special observations are here necessary.

Fittings

Where the attachment of fittings is to be by welding, a realization of the special problems involved is of first importance. Reference has been made earlier to the stresses set up and retained in welded joints. While in certain circumstances these may be accepted in straight butt joints, they constitute a distinct hazard in the case of heavy welds around manhole and branch compensating rings. At these points, even in a pressure vessel of riveted construction, there are high local stresses, but the shrinkage of heavy welds may set up additional stresses. This condition has during the past few years been found to be in part the origin of certain welded pressure vessel explosions in the United States of America, and a subsequent examination of many installed vessels in that country has shown the existence of dangerous stress cracks.

It has been established that the welding of fittings to pressure vessel shells should be followed by stress relieving. In practice, therefore, the designer tries to locate the fittings all in one shell plate, or in as few plates as possible, so that a minimum number of plates with their fittings welded into position need be treated in a stress relieving furnace before being despatched to site.

Typical fitting mounting details are given in Figs. 2 and 3.

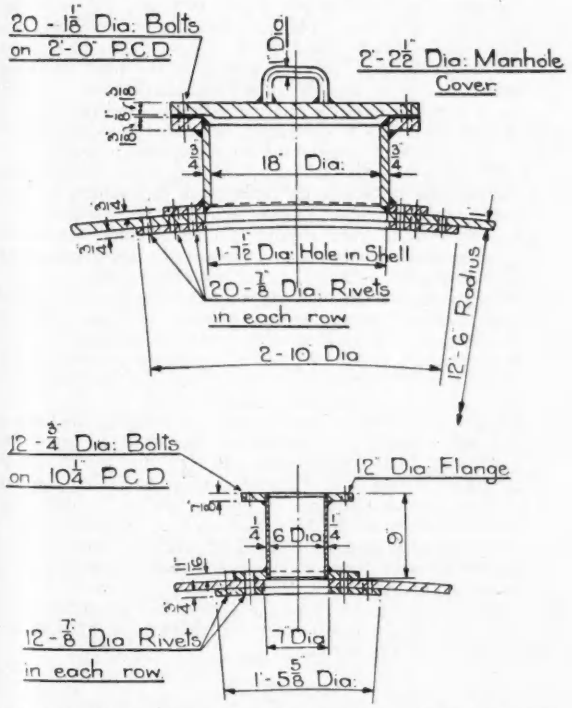


FIG. 2.—*Details of Manhole and Branch for Riveted Construction*

Working and Design Pressures

Good current practice is to set the safety valve, which is of the spring loaded type, to start lifting at a pressure some 10% above working pressure so as to ensure primarily that sun temperature rise in a full holder will not cause escape of gas. Since the safety valve setting pressure is also the design and safe working pressure this 10% margin represents a loss of holder storage capacity. Connected with this 10% range also is the fact that after venting the safety valve does not seat firmly until the holder pressure has fallen several pounds below the setting pressure.

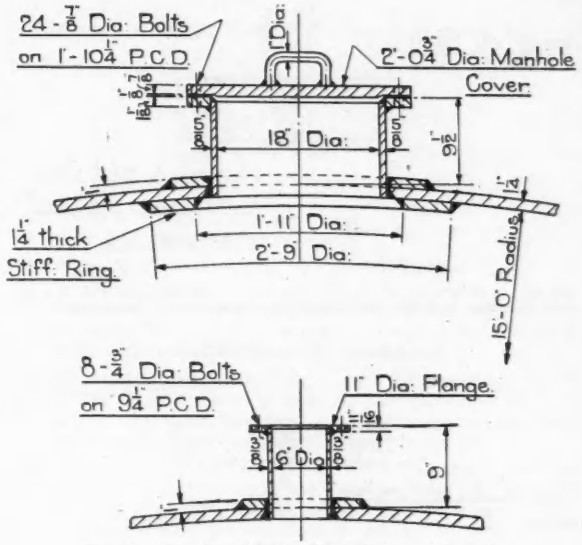


FIG. 3.—*Details of Welded Manhole and Branch*

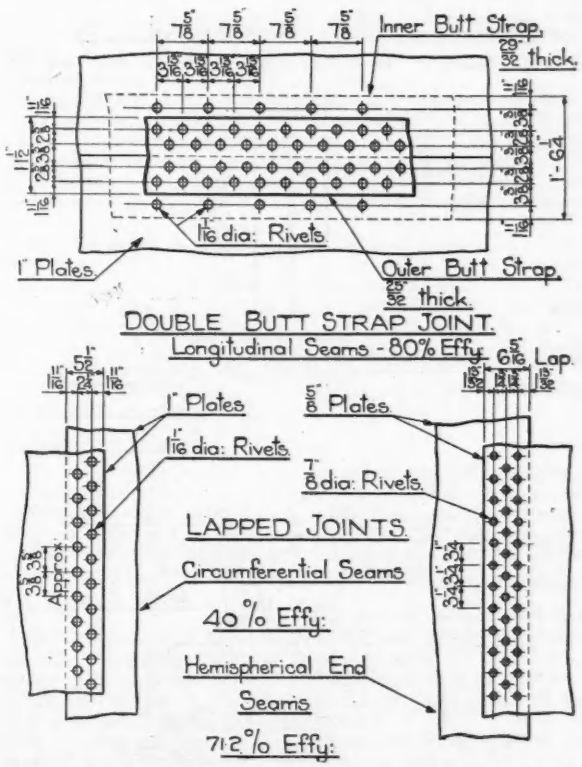


FIG. 4.—*Details of Riveted Joints for a High-Pressure Gasholder*

* From Communication No. 314 of the Institution of Gas Engineers. Presented at the Annual Meeting, 1947.

While, therefore, to-day it is good practice to operate a holder designed, for example, for 77 lb. per sq. in. at only 70 lb. per sq. in., there is the need for investigation into holder temperature changes as well as safety valve types. It should be observed, however, that a relay operated valve is not considered sufficiently reliable to be the sole safety device.

Corrosion

In pressure vessels where the shell plate is permanently stressed nearly to the design figure, an allowance for the effects of corrosion in the form of plate thinning or pitting is important. This matter is recognized in the fact that codes of practice for pressure vessels do not include corrosion as one of the "unknowns" covered by the general safety factor, but require a specified addition to plate thickness after all calculations have been made. In high pressure gasholders for town gas, it is thought that internal corrosion is unimportant. External corrosion is, of course, dependent mainly upon the quality and frequency of painting, and for this reason, as well as for ease and economy in both painting and inspection, it is good practice to equip a holder with travelling ladders which give access to a large part of the external surface.

Unless there are any known local conditions which give rise to accelerated corrosion, the usual codes of practice require an addition of $\frac{1}{8}$ in. to the plate thickness which would otherwise be adequate.

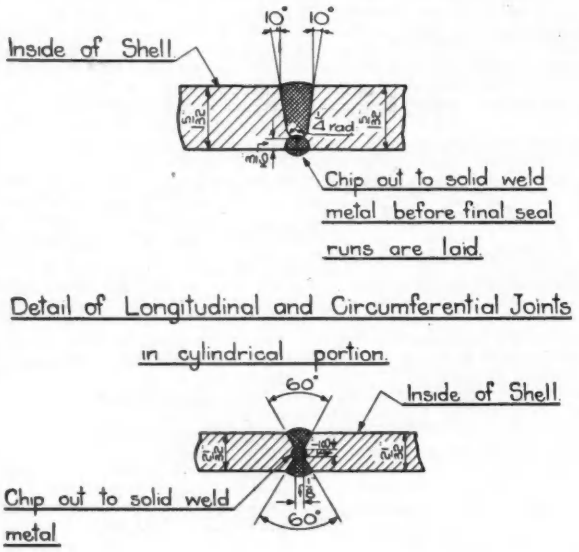

Inside of Shell
10°
10°
4 rad
Chip out to solid weld metal before final seal runs are laid.
Detail of Longitudinal and Circumferential Joints in cylindrical portion.
60°
Inside of Shell
Chip out to solid weld metal
60°
Detail of Joints in hemispherical ends.

FIG. 5.—*Details of Welded Joints for a High-Pressure Gasholder*

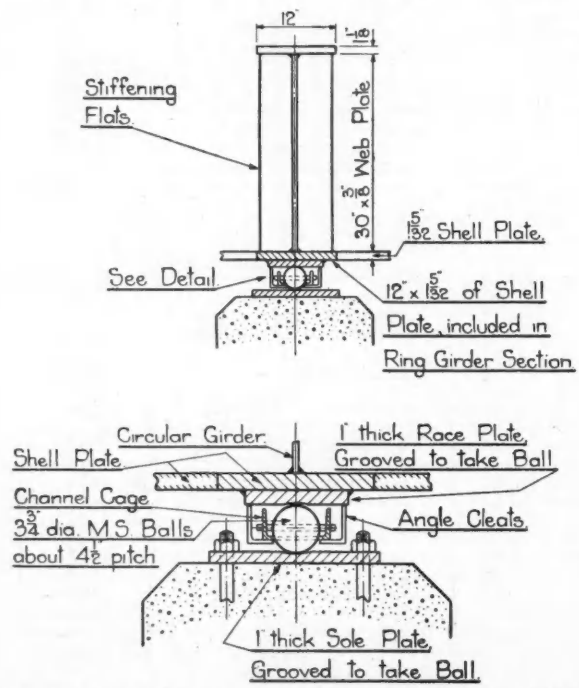

12"
Stiffening Flats
30" x 1⅛" Web Plate
5/32 Shell Plate.
See Detail
12" x 5/32 of Shell Plate, included in Ring Girder Section
Circular Girder Shell Plate
1" thick Race Plate, Grooved to take Ball
Channel Cage
¾" dia. M.S. Balls about 4½" pitch
Angle Cleats
1" thick Sole Plate, Grooved to take Ball.

Fig. 6.—*Details of Ring Girder and Ball Support (Patents applied for)*

Design of a Large High-Pressure Gasholder

In order to illustrate certain of the matters discussed, the detailed calculations relating to both welded and riveted designs for a 73 lb. per sq. in. working pressure holder of 467,000 S.T.P. cu.ft. releasable gas capacity are given in Appendix 3, and Figs. 4, 5, and 6.

Conclusion

Having drawn attention to some of the matters affecting the design and construction of large high pressure gasholders, the Authors make the following observations:

(1) It is in the best interests of the Gas Industry that no considerations of first cost, storage economics or local circumstances should be allowed to obscure the necessity for the highest standards in design and construction. To this end it is desirable that there should be close collaboration between gas engineers, designers and the insurance companies in the drawing up of codes and specifications, particularly during the development period.

(2) The hydraulic test is safer and more rigorous than the air test. It should be accepted and the economics of pressure storage assessed on the higher first code thereby incurred.

(3) A properly designed, constructed, and tested riveted holder may be regarded as sound and reliable and in the tradition of steam boiler practice. The riveted holder is, however, dependent upon the proper driving of rivets, and increasing difficulty is visualized in obtaining the skilled and conscientious craftsmen required. Hand riveting cannot wholly be replaced by power riveting. In consequence, as the trend in steam boiler practice is towards welded construction, so does this trend seem inevitable in pressure gasholder construction.

(4) A properly designed, constructed, and tested welded gasholder is an even better engineering structure than a riveted one. The supervision and testing of welding must, however, be rigorous, partly because the detection of bad welding is more difficult than that of bad riveting, and partly because the known imperfections of good riveting can be accepted because of long accumulated experience, whereas the imperfections of ostensibly good welding (a newer technique) cannot.

(5) With the availability of X-ray weld examination there is no need to accept inferentially proved workmanship as has been the case in the past with riveting. As in steam boiler practice so in pressure gasholder practice, the modern alternative to sound riveted construction is X-ray examined, welded construction to the appropriate insurance code.

(6) For the storage of gas under pressure the suitability and safety of a well designed, built and proved pressure holder cannot be questioned. The Authors hold the view that the choice of construction should lie between riveting and X-ray proved welding. Given assurance of riveting quality to traditional steam boiler standards, the selection will be influenced largely by cost and the availability of skilled craftsmen, but nevertheless some weight should be attached to the engineering perfection of good and proved welded joints.

In the preparation of this Paper the Authors are grateful for the help of their colleagues, and particularly for that of K. W. Francombe, S. Little, and A. F. G. Austin.

Appendix 1

SHORT LIST OF PAPERS ON GAS STORAGE UNDER PRESSURE

GENERAL

[1] The Incident of the Peak Load. F. G. Gorman. *Trans. Inst.Gas E.*, 1928-29, **78**, 160.
(Applicability of pressure storage; annual filling and prime costs; distribution of gas under pressure.)

[2] Spherical Holders. S. M. Milbourne. GAS JOURNAL, 1929, **186**, 196, 253.
(Advantages of pressure storage; releasable capacity *v.* diameter and pressure for spheres; rate of filling; compressor power consumption; general design, &c.)

[3] Choice of Gas Storage. W. S. Hubbard. GAS JOURNAL, 1938, **221**, 323.
(Features of the various types of low-pressure holder, and of the high-pressure holder.)
[4] Design of Distribution Systems to Supply Post-war Development. H. J. Escreet. *Comm. No.* 259, *Inst. Gas E.*, 1943, GAS JOURNAL, 1943, **242**, 73, 104.
(Transmitting and pumping costs ; annual and prime costs of high-pressure and low-pressure gasholders ; distribution losses, &c.)
[5] High-Pressure Gasholders. G. M. Gill. *Comm. No.* 296, *Inst. Gas E.*, 1945-46, *Gas World*, 1946, **124**, 640, **125**, 17, 156.
(General account of the application, prime and running costs, advantages and testing of pressure gasholders.)
[6] High-Pressure Gas Distribution. G. E. Haddon. GAS, 1946, **1**, 236.
(The factors influencing the form of distribution systems.)

ECONOMICS OF PRESSURE STORAGE.

[1] Economic Design of Pressure Vessels. Brummerstedt. *J. Inst. Petrol*, 1945, **31**, 249A.
(Cost of low-pressure vessels for 250 to 250,000 cu.ft. in U.S.A. Cost of high-pressure vessels to hold 50,000 cu.ft. at 10, 25, 50, and 500 atm. abs., showing diameter, plate thickness and weight of cylindrical and spherical vessels.)
[2] Economics and Balance Sheets for High-Pressure Holders. *Gas- und Wasserfach*, Nov. 5 and 12, 1932.

DESIGN OF PRESSURE VESSELS AND CODES OF PRACTICE

[1] Design of All-welded High-Pressure Tank. Bryant, Hill and Binder. *Gas*, May, 1946, **22**, No. 5, 51-52.
[2] Simplified Methods for Calculating Stresses in Pressure Vessels. Boe and Carsten. *Chem. and Met. Eng.*, March, 1946, **53**, 114.
(A method of comparing the formulae derived from the various theories is presented.)
[3] A.S.M.E. Code Unfired Pressure Vessels, Rules for construction of Section VIII, 1943 edition. American Society of Mechanical Engineers, 29, West Thirty-ninth Street, New York, 18 (N.Y.).
[4] A.P.I.-A.S.M.E. Code. Design and construction, inspection and repair. Unfired pressure vessels for petroleum liquids and gases. Fourth edition, 1943.
[5] B.S.S. 487: 1939. Fusion-welded Air Receivers.
[6] B.S.S. 429: 1931. Riveted Steel Air Receivers.
[7] Associated Offices Technical Committee. Rules for the construction, testing and scantlings of fusion-welded steel pressure vessels. Schedules of examination and tests of welded Drums.
[8] Lloyds Register of Shipping. Rules for welded Pressure vessels, 1947.
[9] Third Report of the Gasholder Committee of the Institution of Gas Engineers: 1936. Appendix 9.—Inspection, Maintenance and Repair of High-Pressure Gasholders. *Comm. No.* 144.
[10] The British Corporation Register of Shipping and Aircraft. Rules and Regulations (Section 37), 1944.

ERECTION

[1] Erection Details of Holders at Long Beach, California. *Gas*, May, 1946, **22**. No. 5, 53 to 56.
[2] Large Gasholders at Long Beach Feature All-welded Construction. Hill. *The Welding Journal* (U.S.A.), August, 1946. **25**, 745.
(Short description of the salient features of the design of the holders referred to in Reference "Erection [1]")
[3] Constructing Horizontal High-Pressure Holders. W. A. Sandeberg. *Gas World*, 1941, **114**, 42.
(Outline of erection giving the various stresses for a large holder and describing the method of rotating the shell to enable most of the welding to be carried out in the downhand position.)
[4] American Welding Society. Welding Handbook. Rules for the Field Welding of Steel Storage Tanks. Chapter 38.

INSTANCES OF FAILURE

[1] Field-erected Pressure Vessels. Plummer. *The Welding Journal* (U.S.A.), November, 1946, **25**, 1,081.
(Description of four cases of failure, results of subsequent examination with a discussion of the factors which influence the economy and safety of field erected pressure vessels.)
[2] Failure of Spherical Hydrogen Storage Tank. Brown and Smith. *The Welding Journal* (U.S.A.), March, 1945, **24**, 235. *Mech. Eng.*, 1944, **66**, 392.
(Detailed study of the point of origin and causes of failure, with the Author's conclusions.)

DESCRIPTION OF PARTICULAR INSTALLATIONS

[1] District High-Pressure Storage. GAS JOURNAL, 1940, **231**, 406.
(Full information as to the overall costs of high pressure storage, including description of the compressors and automatic control gear.)
[2] High-Pressure Gas Distribution at St. Ives, Cornwall. F. R. G. Grant. GAS JOURNAL, 1938, **221**, 801.
(A study of the installation of a typical pressure gasholder with its ancillary compressing equipment and distribution system.)
[3] Static High-Pressure Gasholders. Marsh. GAS JOURNAL, 1946, **248**, 69.
(Short description of the 467,500 cu.ft. pressure gasholder referred to earlier in the Paper.)

Appendix 2

RECOMMENDED CODE FOR THE DESIGN OF SITE-WELDED GASHOLDERS

In deciding the plate thickness for the shell and ends of the vessel it is recommended that the following design stresses should be used, according to the particular standard of construction it is proposed to adopt.

(1) With X-ray examination of all longitudinal seams and hemispherical end seams, together with the provision of full mechanical tests representing the seams, a joint efficiency not exceeding 80% should be used in calculating the plate thickness, using the standard formula for thin shells.

$$P = \frac{f \times 2 \times t \times F}{D}$$

Where P = maximum safety valve load in lb. per sq. in.
f = 15,700 lb. per sq. in. for 28 to 32 ton material.
= 14,500 lb. per sq. in. for 26 to 30 ton material.
t = Plate thickness in inches.
D = Internal diameter of vessel in inches.
F = Joint efficiency (fraction).

In the case of hemispherical ends for the formula is:

$$P = \frac{2 \times f \times t \times F}{R}$$

Where R = Internal radius in inches.
Other symbols as above.

(2) With X-ray examination of all longitudinal seams and hemispherical end seams, together with provision of limited mechanical tests representing the seams, a joint efficiency not exceeding 75% should be used in calculating the plate thicknesses, using the formulæ given under (1).

(3) Without any X-ray examination, but including the provision of full mechanical tests representing the welded seams, a joint efficiency not exceeding 72% should be used in calculating the plate thicknesses, using the formulæ given in (1).

(4) Without any X-ray examination, but including the provision of limited tests representing the welded seams, a joint efficiency not exceeding 67% should be used in calculating the plate thicknesses, using the formulæ given in (1).

NOTES

The thicknesses given by the above formulæ are to cover working conditions only. The vessel and its foundations should in any case be suitable to withstand the stresses produced by the hydraulic test to twice the design pressure plus the additional loading due to the weight of water.

In making the above recommendations it is assumed that where X-ray examination is carried out the welds must of necessity be ground flush with the plate on both sides. Where no X-ray examination is made, the welds are to be ground to a smooth contour.

All welding is to be carried out from both sides of the plate, with the bottom of the first side chipped to clean metal before the second side is welded.

All other details of design are to be approved before construction be commenced.

If it is desired to provide some additional thickness of metal to allow for possible corrosion, this is to be over and above the thicknesses calculated by the above methods, and it is recommended that any corrosion allowance be clearly stated. It is considered that some margin for possible corrosion is desirable.

The terms "full tests" and "limited tests" are to bear the following interpretation:

Full Tests

Test plates are to be attached to and welded with the longitudinal seams, and from each set of test plates test specimens shall be cut to provide one tensile test for the welded joint, one all-weld metal tensile test, one bend test with the inner surface of the weld in tension, one bend test with the outer surface of the weld in tension, two impact tests, and specimens for micro and macro examination.

Limited Tests

Test plates are to be provided as in the case of "full tests" but the only test specimens required from each set of test plates are a tensile test for the welded joint, one bend test with the inner surface of the weld in tension, one bend test with the outer surface of the weld in tension, and one nick-break test.

In all cases sufficient test plate material should be allowed for possible re-tests in the event of the original test failing.

Appendix 3

DESIGN CALCULATIONS ROF A HIGH PRESSURE GASHOLDER

(A) DESIGN DATA, DIMENSIONS AND MATERIALS

Releasable gas volume W.P. to zero gauge (Vr) .. .. 467,500 cu.ft. S.T.P.
Working Pressure .. .. .. 73 lb. per sq. in. (gauge)
Design Pressure = W.P. + 10% .. Say, 81 lb. per sq. in. (gauge)
Hydraulic Test Pressure = Design + 100% .. .. 162 lb. per sq. in. (gauge)
Diameter agreed .. .. .. 25 ft.

Required Vessel Volume $= \frac{Vr \times 14.7}{73} = 94{,}100$ cu.ft.

Vessel dimensions for this volume = 25 ft. diameter × 175 ft. long cylinder, + hemispherical ends, or 200 ft. overall length.
Factor of Safety = 4 on minimum ultimate tensile.
Corrosion allowance all plates = $\frac{1}{16}$ in.
Mild Steel Materials:—
Cylindrical Portion .. B.S.S. 14: 1942 = 28 to 32 tons per sq. in.
Hemispherical Ends.. B.S.S. 14: 1942 = 26 to 30 tons per sq. in.
All other parts .. B.S.S. 15: 1936 = 28 to 33 tons per sq. in.

(B) THE HOLDER SHELL—RIVETED

The shell is designed to B.S.S. 429: 1931 (" Riveted Air Receivers "), using " B_3" type joints and 1 $\frac{1}{16}$ in. diameter rivets.

Thickness of the Cylindrical Shell Plates

The plate thickness is obtained from the expression

$$t = \frac{PCD + 2}{S_1E} \quad \ldots\ldots(1)$$

where t is given in 32nd of an inch.
P is the Design Pressure = 81 p.s.i.g.
C for the " B_3" joint = 2.75
D the vessel diameter in inches = 300 in.
S_1 = the ultimate tensile strength of the plates = 28 tons per sq. in.
E = the joint efficiency = 80% (assumed).
On substituting these figures in expression (1), the value obtained for t is 31.8, say 1 in.

Maximum Pitch of the Rivets in the Outer Row

The maximum pitch of the rivets is given by the expression

$$p = CT + 1\tfrac{1}{8} \text{ in.} \quad \ldots\ldots(2)$$

where p is in inches.
C in this case = 6.
T = plate thickness = 1 in.
A value of 7$\frac{1}{8}$ in. is obtained for p.

Efficiency of Joint " E "

The efficiency of this joint is the lowest value obtained from the following expressions

$$E = \frac{100\,(p - d)}{p} \quad \ldots\ldots(3)$$

$$E = \frac{100\,(S_2anc)}{s_1pT} \quad \ldots\ldots(4)$$

$$E = \frac{100\,(p - 2d)}{p} + \frac{100\,(S_2ac)}{S_1PT} \quad \ldots\ldots(5)$$

where S_2 = 85% of 23 = 20.4 T per sq. in.
a = Area of rivet hole = 0.994 sq. in.
n = The number of rivets in pitch p.
c = 1 for single shear rivets.
= 1.875 for double shear rivets.
The efficiencies obtained are 85.3, 80.6 and 80% respectively.
The minimum efficiency of 80% is satisfactory.

Butt Straps

The thicknesses of the inner and outer straps are obtained from the expressions given below:

$$t_0 \text{ (outer strap)} = \frac{5T\,(p - d)}{8\,(p - 2d)} \quad \ldots\ldots(6)$$

t_1 (inner strap) = $t_0 + \frac{1}{8}$ in., but not more than the plate thickness ..... (7)

Hence t_0 = 0.755 in., say $\frac{25}{32}$ in.
and t_1 = $\frac{29}{32}$ in.

Hemispherical Ends
Plate Thickness

" L_3" type joints with $\frac{7}{8}$ in. diameter rivets are employed. Using the basic expression (1), assume a joint efficiency of 71%, take S_1 as 26 tons per sq. in., and C = 2.83. D and P remaining the same, the plate thickness of the hemispherical ends is calculated to be $\frac{23}{32}$ in. to the nearest $\frac{1}{16}$ of an inch.

Maximum Pitch of Rivets

The values of C and T to be substituted in expression (2) in this case are 3.47 and $\frac{23}{32}$ in. respectively. The maximum pitch is therefore 3.905 in., but take 3$\frac{1}{4}$ in. for tightness.

Joint Efficiency

In this case expressions (3) and (4) are solved for E, giving values of 71.2 and 76.2% respectively. The minimum efficiency is satisfactory.

(C) THE HOLDER SHELL—WELDED

The vessel would not be subjected to X-ray examination or heat treatment for stress relief, but full mechanical tests as required by the A.O.T.C. Code for Fusion Welded Unfired Pressure Vessels would be provided. In these circumstances the Code would permit the employment of a " joint factor " (efficiency) of 72%.

Thickness of the Cylindrical Shell Plates

From the theory of thin cylinders:

$$pd = 2\,fe\,t \quad \ldots\ldots(8)$$

where p is the diameter pressure = 82 p.s.i.g.
d is the diameter of the vessel = 300 in.

$$fe = \frac{28 \times 2240 \times 72}{4 \times 100} = 11{,}300 \text{ p.s.i.}$$

On substituting these values in expression (8) the required plate thickness, including the corrosion allowance of $\frac{1}{16}$ in., is found to be 1.1375 in., or, say, 1 $\frac{5}{32}$ in.

Thickness of Hemispherical End Plates

From the theory of thin shells:

$$pd = 4\,fe\,t \quad \ldots\ldots(9)$$

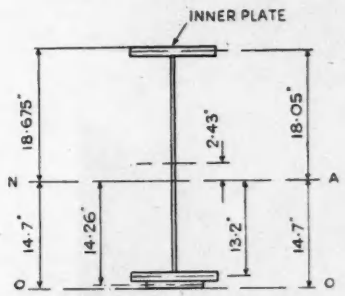
In this case
p = 81 p.s.i.g.
d = 300 in.
fe = 10,500 p.s.i.
hence t = 0.6425 in., including the corrosion allowance, say $\frac{23}{32}$ in.

(D) RING GIRDERS

The length of the cylindrical portion of the shell is 175 ft. Let this be composed of 25 strakes at 7 ft. centres. Let the support spacing be 14 ft.—*i.e.*, at the width of two strakes. The weight of the shell per 14 ft. length at 47.175 lb. per sq. ft. (1 $\frac{5}{32}$ in. thick plate) is 23.1 tons
The Weight of water contained in 14 ft. of shell is .... 192.0 tons
Assume the weight of one ring girder to be..... 2.90 tons..

Then the total load " W " per 14 ft. length is..... 218.00 tons

Consider a ring girder as shown in Fig. 6 (p. 412).



The sectional area is found to be — 45.25 sq. in.

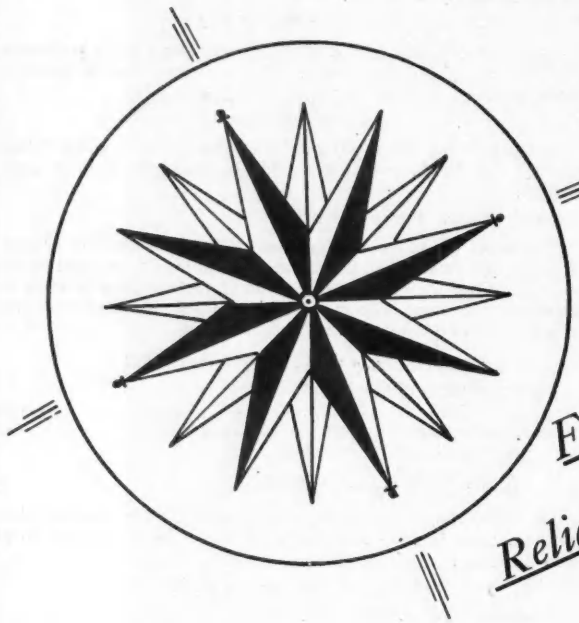
The neutral axis of section is — 14.4 in. from 0——0

The moment of inertia about NA is — 8,990 in^4.

Section Moduli NA_1 = 480 in.^{3} —
Section Moduli NA_2 = 625 in.^{3} —
The bending moment in ring = Mx = 0.025 Wa.
where W = 218 tons
a = Radius to NA of ring
The bending moment is — 749 tons in.
Direct tension in ring = Ho = 0.173 W — 37.7 tons
The stress due to the bending moment — 1.2 tons per sq. in.
The stress due to direct tension — 0.83 tons per sq. in.

The stress in shell plate due to the hydraulic over-pressure of 162 p.s.i.g. — 9.95 tons per sq. in.

Therefore the total maximum hoop stress due to self-weight water and over-pressure — 11.98 tons per sq in.



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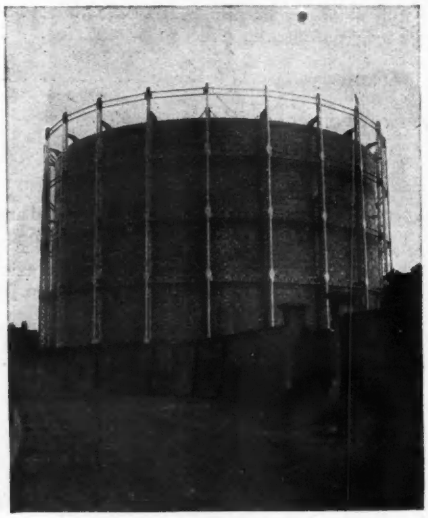

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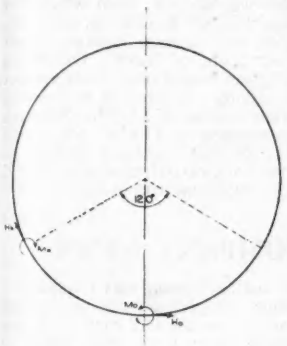
This maximum stress is within the elastic range of the material and is considered satisfactory.

In the above:



$Mo = -0.0462\,Wa$ .....(1)
$Ho = +0.173\,W$ .....(2)
$Mx = +0.025Wa$ .....(3)
$Hx = +0.1014\,W$ .....(4)

Negative Sign in (1) indicates compression in shell.

Positive Sign in (2), (3) and (4) indicates tension in shell.

While the values of (2) and (3) do not occur at the same section, the addition of the stresses is deemed prudent in view of the fact that the support pressure has been assumed as uniformly distributed over the area of support.

(E) BALL SUPPORT (Fig. 6)

The expression for the permissible load per ball is given in "Timoshenko Strength of Materials," Vol II, p. 557, as

$$W = 700\ d^2 \text{ (lb.)}$$

Taking $3\frac{1}{4}$ in. diameter balls, the permissible load per ball is found to be 4.4 tons.

The total vertical load is 218 tons per 14 ft. length.

The effective load on the balls, W_1, is calculated thus:

$$W_1 = \frac{\pi W}{3 \sin\alpha} = 263 \text{ tons}$$

Hence, at least 60 balls are required.

The angle subtended by the support at the centre of the vessel is 120° (2x). Assuming the diameter at the centre line of the balls to be 25 ft. 6 in., the approximate length of the ball path would be 26.6 ft., and the approximate pitch of the 60 balls would be 5.32 in. Therefore, employ 70 balls at $4\frac{1}{2}$ in. pitch. The actual load per ball is then 3.66 tons, which is less than the maximum permissible loading.

(F) GRAND TOTAL WEIGHTS

Welded holder, travelling ladder and supports = 406 tons
Riveted holder, travelling ladder and supports = 420 tons

GAS METER VALVES AND FACINGS

(Contributed)

It has recently been stated that analysis of meter faults shows a large proportion to be due to valve trouble. In some degree, this can be associated with the modern tendency in meter design to employ larger valves and smaller diaphragms. Compared with the old type "lights" meter, the margin of gas pressure available to operate the meter is correspondingly less, and for this reason any resistance to movement caused by sticky valves can lead to faulty operation or even to complete stoppage.

The reliability of a meter is greatly dependent on smooth valve operation. Stickiness and drag at the sliding faces may result in straining, possible distortion of the motions, faulty registration, high absorption of pressure, oscillation, and noisy operation. The problem is one which is being actively investigated both in this country and abroad. The use of an alternative valve material to the alloys, such as tin-antimony, normally used in the Gas Industry has been accepted as a possible solution. Such an alternative material, to be fairly successful, should be inert to solvents carried in the gas, protect the metal counterface from chemical action, and prevent build-up of gummy residue. Certain plastic materials which fulfil some of these requirements have been tried but have not been altogether satisfactory. Carbon, however, possesses the qualities required and for some time past research has been conducted with a view to perfecting a grade suitable for this application.

Either the complete valve or the valve facing only can be produced in a graphitic carbon material. Continental meter manufacturers in particular have been concerned with the evolution of a more satisfactory valve material and they first posed the problem of providing suitable non-metallic facings for the valves some 20 years ago.

These facings took the form of graphitic carbon plates 2 to 3 mm. thick, and early experiments showed very desirable performance characteristics with the valve working against the existing white metal grids. They remained smooth over long periods, were practically non-wearing, and covered the metal counterface with a lubricating graphite film.

At first the use of carbon facings met with a certain amount of conservatism and only very slow progress was made. Continental manufacturers were the initial users on a large scale, particularly in Denmark, where considerable quantities have been, and are being, supplied. The opinion of a number of these meter manufacturers, after having used carbon facings in thousands over the last 12 years, is that wear is negligible over a long period, and valve performance is in all respects superior to that of plain metal valves.

The facings are usually attached to the metal valve bodies by adhesives, with or without riveting. While this is satisfactory in the majority of cases, there remain a percentage which are not entirely successful because the facing becomes partly or wholly detached from the metal valve body. The causes of such failures are, firstly, solvents in the gas which act upon the adhesive, and, secondly, the differential expansion between the metal valve body and the carbon facing. However, Continental meter manufacturers still use the carbon facings for preference, with an acetone-base adhesive, which they state is trouble free.

Following the success of carbon facings, the idea was conceived of manufacturing the complete valve in carbon and experiments were made by various manufacturers with both the straight and the oscillating type. These were a decided success, having all the advantages of the carbon faced valve with none of the disadvantages of the carbon-metal valve.

Carbon is, of course, considerably lighter than the alloy normally used for valves. A valve of simple shape can be adopted since the cost of metal and the question of weight do not have to be taken into consideration.

In one test with a carbon valve in a Continental make of meter it was found that after nearly 1,000,000 movements the wear of the valve was not measurable and both the valve face and the grid were smooth and highly polished.

The advantage of carbon facings and valves may be summarized as follows:

1. Low friction, unaffected by speed variation or impurities or solvents in the gas, ensuring low flow resistance to the gas through the meter and accurate measurements over a wide speed or rate of operation.
2. Low rate of wear and freedom from sticking or roughening at the sliding face, ensuring efficient sealing over long periods.
3. Light weight (with suitable design of mechanism) reducing the inertia of the valve and relieving the operating links and mechanism of unwanted inertia loads. Thus there is greater sensitivity to load change and better reaction to slow movement—*i.e.*, light loads. Dragging is reduced to a minimum and this is very important when efforts are being made to reduce the meter size by using higher operating speed.
4. Silent operation. With metal valves considerable trouble can be encountered with squeak. This is completely overcome.
5. Material is self-lubricating. Introduction of oil spray is, therefore, not only unnecessary but undesirable, as the small quantity of oil which reaches the valve area obstructs the graphite film imparted by the carbon valve.
6. The material is inert to nitrogenous gum carried by the gas.
7. The metal valve-grid assumes a protective coating of graphite preventing any gummy deposit and affording resistance to sulphiding of the metal by any hydrogen sulphide present in the gas.

INDUSTRIAL ACCIDENT PREVENTION

Mr. G. P. Barnett, H.M. Chief Inspector of Factories, will speak at the National Safety Congress at Brighton on Oct. 6-10. The congress is being organized by the Royal Society for the Prevention of Accidents, which this year celebrates its silver jubilee as a national organization.

The industrial sessions will include Papers on safety methods in American factories by Mr. L. N. Duguid, H.M. Superintending Inspector of Factories, and Mr. R. E. Tugman, of Imperial Chemical Industries, Ltd., both of whom have recently visited the U.S.A. Another session which promises to be of interest arises out of experiments now being made in the safety training of foremen and supervisors by means of discussion group methods. By the time the congress is held these experiments will have progressed sufficiently for a report to be made.

The more detailed matters to be discussed include noise abatement in industry, floor surfaces and their effect on falling accidents, and the guarding of milling machines. The main industrial sessions will begin on Oct. 7 and end on the afternoon of Oct. 9. Full particulars of times, fees, &c., may be obtained from the Industrial Safety Division, Royal Society for the Prevention of Accidents, 131, Sloane Street, London, S.W.1. Details of the public safety sessions may be obtained from the Society's head offices at 52, Grosvenor Gardens, London, S.W.1.